

APPENDIX B

Enhanced Evaporation Pilot Study Work Plan



Work Plan for Enhanced Evaporation Pilot Test

**Anaconda Mine Site
Yerington, Nevada**



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**Work Plan for Enhanced Evaporation Pilot Test - Draft
Yerington Anaconda Mine Site**

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1.0 Introduction

This work plan provides the details of SPS's proposed enhanced evaporation pilot test to provide an opportunity to increase the available capacity of the fluid management pond components of the Anaconda Mine Site OU8 Fluid Management System (FMS). Under the terms of 2007 and 2009 EPA Orders (USEPA, 2007, 2009), Atlantic Richfield Company (ARC) currently performs operations and maintenance (O&M) of the system and prepares monthly and annual monitoring reports.

The volume of drain-down solutions has significantly decreased since Arimetco operations ceased in 1999, as of 2014 averaging less than 10 gpm. Even with the reduced volume of drain-down solutions, it is estimated that existing FMS ponds may run out of capacity by 2019.

SRK, Inc. under contract to SPS completed an FMS Study that, among other things, recommended enhanced evaporation as a method to extend the life of the FMS (SRK, 2013). Commenters to the SRK Study recommended a pilot test to confirm the efficacy of enhanced evaporation at the site.

Recent discussions between EPA/NDEP/ARC/SPS regarding a State-lead approach to overall site closure began in early 2015. As part of these discussions, SPS voluntarily offered to perform an enhanced evaporation pilot test to increase the capacity of the FMS ponds which would provide additional time to secure private funding to close the orphan OU8. SPS offers this work plan in furtherance of its voluntary offer to assist in finding alternatives to federal funding of the closure of OU8. SPS performing the pilot test field work is conditioned upon receipt of appropriate agreements. If the results of the evaporation pilot test are successful, the capacity of the FMS could be extended by several years, providing additional time to secure private funding to close OU8 while also evaluating restarting mining at the site.

2.0 Project Team

Singatse Peak Services, LLC (SPS) will take the lead role in planning, designing, constructing and operating the enhanced evaporation pilot test. All work will be coordinated with EPA, NDEP, BLM and ARC and prior to the start of the pilot test this work plan will be reviewed by these parties. SPS will work with a local contractor to assist in building and operating the pilot test.

During the pilot test, ARC will continue to operate the FMS except for SPS's removal of fluids from specified FMS ponds to feed the enhanced evaporation system.

3.0 Summary of OU8 Components

This section of the work plan summarizes key components of OU8 and the FMS. This information was summarized from various reports associated with OU8 (Brown & Caldwell, 2010a, 2010b and 2015).

Fluid Management System (FMS) Components - The main components of the FMS are shown in Figure 3-1, and described below:

- Five lined Heap Leach Pads (HLPs) and perimeter collection ditches;
- Six HLP drain-down collection ponds
- Approximately 25,000 feet of piping and transfer pumps;
- Five FMS Evaporation Ponds
- Evaporative sprinkler system on the Phase IV Vat Leach Tailings (VLT) HLP which is used as an emergency backup in the event pond levels exceed operational levels;
- Electrical power supply system;
- Various flow measurement devices, and
- Eight pressure transducers on the FMS Ponds.

A key component of the FMS is the six ponds that collect drain down fluids from the HLPs. The characteristics of each pond are summarized in Table 3-1 (copied from Brown & Caldwell, 2015). The total capacity of the ponds listed in Table 3-1 is approximately 10.8 million gallons. Table 2-1 does not include capacity for the FMS Evaporation Pond (i.e., the EPA 4-Acre Pond) because this pond is filled with mineral salt precipitates and has limited fluid storage capacity.

Table 3-1. Arimetco FMS Pond Design Specifications (from Brown & Caldwell, 2015)								
Description	Slot 2 Pond	Slot Sed Pond	Phase I/II Pond	VLT Pond ²	VLT Sed Pond	Evap. Pond B	Evap. Pond C	Total
Crest Area (square feet)	44,384	6,681	15,368	44,400	~9,000	46,854	46,854	297,514
Crest Area (acre)	0.97	0.15	0.35	1.02	~0.21	1.07	1.07	4.84
Total Depth (feet)	22	6	8	18	NA	8.8	8.8	NA
Operational Maximum Water Depth (feet)	20	4	6	13	NA	6.8	6.8	NA
Maximum Operational Capacity (million gallons)	3.1	0.14	0.43	1.9	0.053	1.7	1.7	9.0
Operational High Water Freeboard (feet)	1	1	1	2.5	2.5	1	1	NA
Operational High Water Depth (feet)	21	5	7	15.5	NA	7.8	7.8	NA
Highest Operational Capacity (acre-feet)	10.4	0.61	1.53	7.98	~0.16	6.13	6.13	32.9
Highest Operational Capacity (million gallons)	3.4	0.2	0.5	2.6	~0.053	2.0	2.0	10.8
Primary Drain-Down Source(s)	Slot HLP	Slot HLP & leak detector	Phase I HLP	VLT HLP & Leak Detector	VLT HLP	Phase III HLP	Phase III HLP	NA

NA = Not applicable

¹ Operational water level increased from eight to nine feet by EPA (Letter entitled "Approval of Operational Level Increase, Anaconda Yerington Mine Site/Arimetco Fluid Management System (FMS)," dated January 11, 2012).

² VLT Pond storage capacity and surface area shown are after liner replacement.

FMS Conveyance - Many of the FMS components were in place during Arimetco operations.

Modifications by NDEP and EPA since 2000 have improved system performance, eliminated areas with the potential for drain-down solutions to escape containment, and increased the storage and evaporation capacity. If needed for emergency operations, solutions can be pumped from the VLT Pond to the top of the Phase IV VLT HLP for evaporation.

The pumps employed for fluid management at various ponds in 2014 are summarized in Table 3-2. Pumping rates are expressed as gallons per minute (gpm). Pump curves are provided in Appendix A. After evaluating the pump curves, it is possible that one or more of the pumps could be used for the pilot test. SPS will select the pump(s) to be used in the enhanced evaporation pilot test, and will coordinate this request with ARC. Potential modifications to plumbing and or/electrical systems made by SPS will be documented prior to the start of the test.

Table 3-2. Arimetco FMS Pump Information				
Location	Discharge Diameter (inches)	Manufacturer	Size (hp)	Measured Pump Rate (gpm)
VLT Sediment Pond (backup)	8	Durco	25	250
Out for repair (to be backup)	4	Durco	15	200
Slot Sediment Pond	4	Goulds	20	250
VLT Storage Pond Diesel Pump	4	Godwin	40	300

Note: Fluid transfers at the Slot Pond are a two-stage process. The first stage transfers fluid from the Slot Pond II to the Slot Sediment Pond with a 2 hp submersible pump. The second stage transfer is made with a 20 hp pump up and over the Slot HLP to Ponds B, C or the VLT pond.

FMS Flow and Pond Level Measuring Instruments - The Slot Pond weir uses a data collector of fluid elevation behind a weir to measure flow. In-pipe volumetric weirs with bubble flow meters are used on the 16-inch diameter inflow lines to measure flows from the Phase III HLPs to FMS Evaporation Ponds B and C, and to the VLT Pond. The instrumentation on the weirs records data at one-minute intervals. Pressure transducers record data at 30-minute intervals. Pressure transducers with data loggers are also used to monitor fluid levels in the FMS ponds. SPS or ARC will continue collecting pond level, pump flow rates and pipe flow rates data during the pilot test.

Contingency Operations – The contingency plan, as approved by EPA and NDEP, includes pumping fluids into the VLT pond which has additional capacity if the fluids are allowed to back up onto the double lined VLT HLP. From the VLT pond, fluids can be pumped to the top of the Phase IV VLT HLP for enhanced evaporation through a sprinkler system attached to four-inch distribution lines on top of the HLP. It is not anticipated that contingency operations will need to be deployed during operation of the pilot test. SPS will coordinate with ARC, EPA and NDEP in the event conditions warrant initiating emergency operations.

4.0 Objectives of Pilot Test

Enhanced evaporation is used to manage excess solutions in the mining industry across the western US and in many parts of the world. The primary objective of the pilot test at OU8 is to obtain empirical data to design a full-scale evaporation system to extend the life of the FMS ponds by several years. A specific estimate of extension of the FMS capacity will be determined from data collected during the pilot test.

SPS will test two sprinkler types over a range of fluid application rates to achieve optimum evaporation while preventing re-circulation of excess fluids back to the HLP liner. SPS also will test use of a water truck to spray fluids on top of selected HLPs during the pilot test.

Soil monitoring probes will be installed below the test areas to monitor moisture content and to determine the optimum fluid application rate that will not result in fluids reporting back to the HLP liners

A key component of the pilot test will be to understand how to minimize solids build up and clogging of sprinkler heads and to assess the O&M required for mitigating this problem. There have been significant improvements in sprinkler head design over the past decade to alleviate this issue.

Qualitative performance criteria used to define success of the pilot test generally fall into three categories; water balance, maintenance, and cost effectiveness.

- a. Criterion #1, Water Balance - The performance of the pilot test indicates that enhanced evaporation is technically feasible to design and operate a full scale system that will evaporate enough fluid to achieve zero net annual fluid accumulation in the active ponds over next 10 years.

The most important aspect of the pilot test will be to determine how much fluid can be evaporated with the enhanced system. The active ponds are the VLT, Slot, B and C ponds. Based on the difference in fluid elevations in the ponds between Jan 1 and Dec 31, the excess fluid generation was approximately 643,000 gal in 2015 and 1.3 million gallons in 2014 (the two years since the ponds have been in the current configuration). Therefore, to be conservative, the full scale system will be sized to evaporate up to 1.5 million gallons each season to achieve the goal of no net fluid accumulation. Given the modular nature of irrigation/evaporation systems, the size of the full scale system can be increased or decreased as weather or other conditions change.

- b. Criterion #2, Maintenance - The maintenance required to achieve the successful water balance result above is technically achievable without excess labor or other cost.

It is anticipated that buildup of precipitates at the sprinkler heads may cause clogging and require periodic maintenance. The sprinkler heads to be tested during the pilot are simple to remove, clean and/or replace. The cost of replacement heads is minimal (< \$10/head) and will be evaluated as to cycle times to maintain in good working order. The pump and piping may also require ongoing maintenance which will be performed as needed. The labor required to perform maintenance will be estimated from the pilot test and used to quantify maintenance costs of a full scale system.

- c. Criterion #3, Cost Effectiveness - The costs to build, operate and maintain a full scale system are in-line with the benefits that the system would provide.

This criterion will be quantified at the time a go/no-go decision to operate a full scales system is be made. For example, if the decision to cap OU-8 has been made and funds are in place, the benefits of operating the system may be low. However, if funding is not in place and the pond levels continue to increase, the benefits of enhanced evaporation may justify a higher cost to operate such a system. We do not believe it is necessary to quantify the acceptance of cost at this time, rather to perform a detailed assessment of cost effectiveness after the results of the pilot test are available.

The data from the pilot test will be use to design a full scale system capable of evaporating up to 1.5 million gal/season over a defined timeframe and over a defined area on top of the HLPs. This will in turn inform the costs to construct, operate and maintain the system. Key variables that will affect the cost of a full scale evaporation system include the upfront capital, operation and maintenance costs. These costs include both equipment and labor costs which will be directly proportional to the size of the system and the labor required to operate the system. For planning purposes, it is estimated that upfront capital costs will range between \$100k to \$200k, depending on the location(s) of the full scale system and the electrical and mechanical (pump/piping) upgrades that will be required. Operating costs of the full scale system are estimated to be the order of \$100k to \$150k/yr assuming 6 months of operation each season. Since we do not have a baseline of the costs of maintaining the fluid component of the current FMS it is difficult to compare the cost of operating the enhanced evaporation system to existing O&M costs.

5.0 Legal Agreements

SPS requires an appropriate and comprehensive agreement with NDEP to address liability issues that third parties or the agencies could attempt to attach to SPS. SPS voluntary offered to assist NDEP, EPA, ARC and the community on resolving the OU8 unfunded closure costs. This voluntary offer should not be met with liability. SPS has prepared this work plan without having such an agreement in place. However, SPS will not commence field work until such an agreement has been executed.

6.0 Technical Considerations

Technologies Considered - SPS reviewed several alternatives for enhanced evaporation. Technologies considered included irrigation (using sprinklers, wobblers or drip emitters), a water truck, and

mechanical evaporators. The pilot test will evaluate two types of sprinkler heads and the water truck approach.

Irrigation Methods – During irrigation, fluids are pumped through a system of pipes to the sprinkler heads. At each sprinkler head, the fluid is sprayed into the air through a nozzle that breaks the fluid into small droplets which fall to the ground surface. The pump system, sprinklers and operating conditions are designed to uniformly apply water to the soil. This is accomplished by distribution lines that are connected to a manifold piping system at pre-determined spacing. The sprinkler heads are installed in the manifold so that the fluid is applied at a set spacing between the sprinkler heads and header lines. Spacing depends on the application rate and substrate size, gradation and type. For the enhanced evaporation pilot test, spacing will be optimized to achieve maximum evaporation.

Three types of irrigation heads were considered for the enhanced evaporation pilot test.

- Traditional sprinkler heads use physical or mechanical action to break the fluid stream into fine particles or mist. The smaller size droplets yield higher evaporation rates. The two types of sprinkler heads to be considered for the pilot test are made by Senninger Irrigation, Inc. (Superspray) and Nelson Irrigation, Inc (Rotator R3000). Data sheets and performance specifications of these sprinkler heads are included in Appendix B. Other types of sprinkler heads and nozzles are available and may be tested as part of the pilot test, depending on performance.
- Wobblers are designed to minimize evaporation (as is preferred in heap leach and agricultural applications) and this design was not considered for enhanced evaporation.
- Drip emitters are also designed to minimize evaporative losses and runoff and this design was not considered for enhanced evaporation.

The maximum pressure anticipated during the pilot test is less than 100 psi. This includes approximately 60 psi head pressure to account for the difference in elevation between the VLT pond and the top of the VLT HLP. Maximum pressures at the sprinkler heads will be in the range of 25 to 40 psi which is well within the pressure specifications of the sprinkler heads and other fittings.

We have not been able to determine the standard dimension ratio (SDR) of the HDPE pipe used to convey fluid to the top of the HLPs, however given the low pressures to be used during the pilot compared to the pressures that Arimetco would have used during full scale heap leach operations, it is reasonable to assume that the existing HDPE pipe can handle well more than 100 psi. As an added precaution, prior to running the pilot test the system will be pressure tested with clean water at 1.5x the maximum operating pressure, or 150 psi.

Currently, the fluid system is operated at similar pressures when performing the annual testing of the contingency pumping system on the VLT or when pumping over from the slot pond over the slot HLP. All other components will be selected to handle pressures of 100 psi. The valves and sprinkler heads are all standard irrigation equipment with design pressure ratings of 100 psi or more.

SPS will follow all manufacturers' recommendations for the sprinkler heads and valves. Any new welds will be performed by a qualified contractor with experience in welding HDPE pipe. As previously mentioned, the entire system will be pressure tested at 1.5x the maximum operating pressure using clean water prior to the start of the pilot test.

7.0 Pilot Test Design

Previous Work by SRK - SRK completed conceptual design work during the FMS Study (SRK, 2013). The design included drip irrigation panels installed on the top of a HLP, where draindown solution from the FMS ponds would be pumped to the drip panels on a rotating basis at a relatively low rate. SRK planned to start with approximately 1 gallon/square foot/day (approximately equivalent to an irrigation rate of 1.67 inches/day) and then modify the rate depending on the initial results. The combination of low rate fluid application and rotating the panels would allow the solution to evaporate during the peak evaporation period of May through October. The proposed design of the panels was to evaporate fluids in the upper two feet of the HLPs with no incidental fluid reaching the liner. The initial size and number of panels were to be updated as operational data were collected during the first year of data collection. The additional benefit of this system is that much of the precipitating sludge is deposited on top of the HLP rather than building up in the lined FMS ponds.

Comments received from the EPA, NDEP and other stakeholders on the SRK design are summarized in Table 7-1, along with the mitigation to each issue. Several commenters suggested running a pilot test to verify the performance of enhanced evaporation. The proposed pilot test addresses this concern. SPS has agreed to operate the enhanced evaporation pilot conditional upon entering into appropriate agreements as discussed in Section 5.

Table 7-1. Summary of Issues Identified in the SRK Evaporation Study

Issue	Mitigation
Fluid application rate and performance	Perform pilot test
Clogging of nozzles/sprinklers	Address in pilot test; test various head types, daily O&M
Blinding of HLP surface (<i>Note 1</i>)	Mechanical tillage, if/as needed

Overspray	Shut down during excessive wind
Precipitate creates dust on HLPs	Shown not to create dust (Pond A)
Accessibility to top of HLPs	Improve existing access roads
Stability of HLPs	No change to loading of the HLPs is anticipated as a result of the evaporation pilot. If needed, stability analyses will be performed as part of full-scale design
Operatorship of evaporation system	SPS has agreed to operate the pilot test, conditional on Agreements in place

Note 1: Blinding is defined as a significant reduction in infiltration on the surface of the HLP.

Sprinkler Irrigation System Design - The first step for design and layout of the evaporation pilot is to determine the optimum rate of fluid application on the surface of the HLP. This process will start with a low rate of 0.5 in/day. The sprinkler head design is selected to cover the specified area with a given flow rate in gallons per minute (gpm). The piping and pump sizes are selected to apply the desired flow rate at the design pressure. Given that these performance specifications are typically provided by the manufacturer using water, the rates are estimates that consider the high TDS (and therefore higher specific gravity) of the FMS solutions.

For the pilot test, a mid-range sprinkler head size was selected with the nozzle orifice sized to achieve 5 gpm at a pressure of approximately 40 psi. The pilot test will start with 4 panels with dimensions of approximately 90 ft wide by 150 ft long, or 13,500 ft² (0.3 acres). For the initial operation, the desired radius of coverage is 15 ft (30 ft diameter) at each sprinkler head. Each 90 x 150 ft panel will include 15 heads for a design application rate of 75 gpm/panel. It is expected two panels will be operated at the same time resulting in 150 gpm. To achieve this rate, the panels will be operated initially for 56 minutes (approximately 1 hr) daily resulting in approximately 0.5 inches of application each day followed by an appropriate resting period to allow for near-surface evaporation to occur. Four panels will be built at the start of the pilot for a total daily application rate of 18,000 gal/day. For a 4-month pilot test, five days/week, the total fluid application is estimated to be approximately 1.15 million gallons. This volume assumes 80% uptime to account for weather and other unplanned downtime of the system.

The irrigation test is planned on the top of the VLT HLP (Figure 7-1). Figure 7-1 also shows the location of the pump, piping to the top of the VLT HLP, flow meter and the manifold to the 4 panels. Pressure gages will be installed at the following locations: downstream of the pump, at the upstream side of the sprinkler manifold and at the farthest downstream end of the system. The gages have not been selected but will be compatible with low pH fluids and the design pressures anticipated. As a practical matter, we will be able to observe whether the sprinkler heads are functioning properly without pressure gages and the pumps can be adjusted to accommodate a range of sprinkler head design pressures.

SPS will follow the manufacturers' recommendations for the various pilot test components such as valves and sprinkler heads. Special maintenance is not anticipated for the pumps or piping since these components are currently being used to pump fluids. This issue will be further discussed during the pre-test meeting with ARC. SPS will provide any required maintenance of the components being used for the pilot test that would normally have been maintained by ARC.

The existing piping configuration on the top of the VLT HLP is the preferred location for the pilot irrigation test given that existing piping is already in place and the top of the VLT HLP is relatively level which will require minimal site preparation to accommodate the irrigation pilot test. Modifications to the VLT HLP will include grading and installing risers and sprinkler heads to evenly distribute fluids on the surface of the HLP.

For improved uniformity of fluid application at the surface, pressure regulators may be installed upstream of the sprinkler heads. Pressure regulators in sprinkler system design are typically used to stabilize a varying inlet pressure to a constant outlet pressure, regardless of changes in the system pressure due to hydraulic conditions, elevation changes, and pumping scenarios. This will in turn create a more uniform rate of water application, controlled sprinkler performance (droplet size and throw distance), and flexibility in overall system operation.

Based on preliminary discussions with ARC, the plan is to use one of the existing pumps for the pilot test with the understanding that short term use for the pilot test will not affect other needs of the pumps for regular O&M. Either the portable Godwin diesel powered pump or the existing 25 horsepower Durco electric pump are planned to be used for the pilot test. Final selection of the pump(s) for the pilot test will be determined in discussion with ARC during the pre-test coordination meeting. The pump curves are provided in Appendix A and show that adequate pump rates and pressures can be accomplished using either pump for the pilot test.

Water Truck Design – Since the draft work plan was prepared, the water truck approach may not be practical for the pilot test due to the lack of available equipment. If the water truck approach continues to be pursued for the pilot test, a plastic tank will be fitted with a manifold at the side of the truck to apply fluids. Side discharge was selected to eliminate tracking of fluids or precipitate outside the limits of lined areas of the site. The manifold will be designed such that fluids will be evenly spread from one side of the truck. The speed of the truck and rate of application are key variables that affect the amount of fluid to be applied. The application areas on top of the both HLPs will be designed in a pattern that will allow the truck to maintain forward motion without driving on areas of applied fluids.

The discharge nozzle on the truck will be manufactured from stainless steel to minimize effects from low pH fluids and corrosion. The nozzle will be sized to provide coverage of 50 to 60 ft perpendicular to the direction of truck travel.

The panels for the water truck test are proposed to be located on the Phase III South and Phase III 4X HLPs. Each panel is estimated to be approximately 5 acres as shown in Figure 7-2. For planning purposes, it is estimated that 4 loads at 3,000 gal each, will be applied each day, resulting in 12,000 gal/day over 10 acres. The water truck approach would be run for a period of several weeks to test the concept. If the concept is shown to have potential, the duration of the pilot may be extended. As with the sprinkler approach, the number of loads and acreage will be adjusted during the pilot test to optimize performance while preventing over application resulting in circulation of applied fluids to the HLP liner system.

Performance Monitoring - During the pilot test, daily operations will be performed as fluids are applied to the evaporation panels. Fluid application rates (i.e. flow rates) will be monitored and adjusted to prevent circulation of excess fluids back onto the HLP liners.

To assist with evaluation of the amount of fluid that is being evaporated and retained in the upper few feet of the HLP, soil moisture sensors will be placed at two depths beneath each evaporation panel. The sensors will initially be placed at a depth of 1.5 and 3 ft, which is estimated to be within the evaporation zone of the HLP surface. These depths may be adjusted during the test based on actual conditions. The soil moisture sensor proposed for use during the pilot is manufactured by Spectrum Technologies, Inc. Specifications. Installation procedures for the moisture sensors are included in Appendix C. Other manufacturers of soil moisture sensors are also being considered and any changes would be documented in the final report.

Fluid volumes applied to the HLPs will be estimated by the using pond elevation/capacity curves for each pond. These curves are provided in Appendix D. Routine flow measurements will be continued for each of the FMS ponds. In addition, the pumping volumes will also be estimated using pump run times and the pump curves. Along with the soil moisture data, these flow data will be compared to the precipitation data collected from the two on-site meteorological stations to verify that applied fluids are not recirculated back to the HLP liners.

8.0 Construction

The initial construction step is to provide for improved access to test locations at the top of HLPs. Each test location will then be surveyed and staked according to the specifications discussed in Section 7.0. Each test area will be leveled with a dozer to prevent potential run off of applied fluids. A small perimeter berm will be constructed, also using a dozer, around the test areas to further prevent run off from the test locations.

Irrigation Approach - For the sprinkler irrigation approach, the piping and sprinkler layout to be constructed at the top of the VLT HLP is shown in Figure 7-1. At the pump location adjacent to the VLT HLP, a liner will be placed outside of the area of the perimeter ditch around the VLT HLP so that potential leakage outside the lined HLP will be on containment.

The main header pipe to pump fluid from the VLT Pond to the top of the VLT HLP will be 4 inch HDPE pipe, with welded seams. At the top of the HLP, the existing header piping will be used to create the irrigation manifold. A 1-inch diameter HDPE riser pipe will be used to attach the sprinkler heads to the manifold pipe. Valves will be located on the header and manifold pipe so that adjustments to the number of sprinklers to be operated at one time can be varied. The valves will also provide flexibility to perform maintenance at selected sprinkler heads without having to shut down the entire system.

As discussed above, the pump selected for the pilot irrigation test is anticipated to be either the existing 25 horsepower electric pump (Durco) currently located at the VLT pond as a backup pump, or the portable diesel powered pump (Godwin). The pump discharge piping will be modified to connect to the irrigation header and manifold system. During the pilot, the current two-stage O&M procedures will be maintained whereby fluids are first pumped from the slot pond into the slot sediment pond using the existing 2 hp electric pump. From the slot sediment pond, fluid is then pumped over the top of the slot HLP to either the B, C or the VLT pond.

The existing piping layout on the top of the VLT HLP is the primary location to be used for the irrigation pilot test. This location has several advantages over the slot HLP location since the piping and pump are already in place (Figure 3-1). Following leveling of the surface of the VLT HLP, modifications to the piping will include installing risers and sprinkler heads to evenly apply fluids on the surface of the test area. The Slot HLP location may be used as a backup location if short circuiting of fluids at the VLT does not allow for adequate evaporation.

Water Truck Approach - For the water truck approach, the pilot test will be located on top of the Phase III South and Phase III 4X HLPs (Figure 7-2). The fluids for the water truck approach will be sourced from either Pond B, Pond C or the VLT pond. These ponds were selected due to having better accessibility and shorter haul distances compared to the Slot or Phase 1 Ponds. A portable pump will be used to load the truck. As with the irrigation approach, the pump and all piping not already over the pond liner will be placed on a liner to be constructed at the load out area(s).

The application areas on top of the both HLPs will be constructed in a pattern that will allow the truck to maintain forward motion without driving on areas of applied fluids.

9.0 Startup and Operation

During the pilot test, an adaptive management approach will be used to achieve the goals of the test. Adaptive management starts by predicting the performance based on best judgement or previous experience, designing and implementing the alternative, monitoring to assess and understand performance, and then use the early results to adjust the operations. This will be an iterative approach to optimize the design and performance of the evaporation pilot test which will ultimately be used to design a full scale system.

Irrigation Startup and Operations – Startup of the pilot irrigation system will begin with pressure testing the piping with clean water to identify leaks. Leaks will be repaired prior to charging the system with FMS solutions.

Prior to initiating pumping each day, the operator at the bottom of the HLP will start the pump and be in radio communication with a spotter located at the top of the VLT HLP to observe sprinkler operation. The appropriate valves will be opened (and closed) to charge two panels at one time. The system will be run to observe performance and adjustments will be made as needed. The daily routine will include the following sequence:

- Check weather forecast
- Pre-start pump check
- Pre-start sprinkler system check
- Start pump, observe operation

Data to be collected will include weather (precipitation, cloud cover, temperature, humidity, wind speed and direction), flow rates, pump run time, and document issues or problems encountered. A daily checklist will be prepared and filled out by the operators.

SPS will have on site, full-time observation while the pumps are running during the pilot test. This will allow for quickly shutting down the system if leaks in the piping occur, erosion of the HLP surface develops or if other unanticipated issues arise during the test.

SPS anticipates that buildup of precipitates will require periodic maintenance of the sprinkler heads during operation of the pilot test. The various manufacturer recommendations will be followed during the test and spare replacement sprinkler heads will be kept on hand so that they can be quickly replaced as needed.

Water Truck Start Up and Operations – Prior to testing the truck with FMS fluids, the operation will be tested using clean water. The initial testing will assure proper functioning of the various system components so that adjustments can be made prior to use on the HLPs. During the shakedown period, truck speed and flow rate will be adjusted to estimate the initial rates for FMS fluid use. Differences between clean water and FMS fluids are expected given the higher specific gravity (SG) of the FMS fluids.

Coordination with O&M Activities Performed by ARC - An important consideration during operation of the pilot test is coordination of ongoing O&M activities at OU8. ARC performs O&M following an O&M Plan prepared in 2010. O&M includes the following activities (ARC, 2015):

- Maintain and repair pond liners, anchor trenches and perimeter ditches;
- Conduct monthly monitoring of pond levels, inflow rates and pumping rates;
- Maintain leak detection systems and record leakage;
- Maintain flow meters, weir inflow level meters, and pond level transducers;
- Maintain EPA's bird deterrent system at the Arimetco FMS ponds
- Collect samples of drain-down solutions for lab analyses; and
- Report FMS activities and data including FMS solution transfer volumes, average drain-down rates and pond levels to EPA.

During the pilot test, ARC will continue to perform many of the O&M activities described above. However, SPS will take over responsibility for transferring fluids to the pilot test locations on top of the HLPs. Any modifications to piping or electrical systems will be documented with P&IDs and as-built drawings so that they can be included in updates to the O&M Manual.

ARC will continue to be responsible for maintaining the fluid levels within the ponds at or below designated fluid levels. SPS will be responsible for ensuring that ARC is made aware of substantial changes in pond fluid levels. Details of the communications will be finalized during the joint pre-test coordination meeting.

SPS also will prepare a stand-alone Data Summary Report (DSR) at the completion of the pilot test. The DSR will include all fluid flow and mass balance data suitable for use in updating the FMS water balance as part the 2016 Annual O&M report to be prepared by ARC.

Prior to construction of the pilot test, SPS and ARC will attend a joint work session with the current field operators and engineers of the FMS. The output from this meeting will be to document changes to O&M procedures that may be required during operation of the pilot test, including preparation of a detailed checklist that defines the roles and responsibilities of each party. This document will be prepared by SPS

and agreed to by both parties prior to the start of the pilot test. This approach will ensure that all required O&M activities will be performed during the pilot test.

SPS will maintain and repair any equipment or FMS components (e.g, pumps, piping, valves, etc.) that are used during the pilot test. SPS does not anticipate replacing or repairing existing liners since these components are not being altered as a result of operating the pilot test.

In any case, the pilot test will be operated so as to not interfere with ongoing operation of the FMS by ARC. In an emergency situation, the pilot test would be shut down if ARC needs to use the pump being used for the pilot test.

10.0 Health & Safety

All field activities will be conducted in accordance with SPS's Safety, Health, Security and Environmental (SHSE) Manual. Copies of the SHSE Manual are located at SPS's office and are available to all site workers. SPS will follow ARC H&S plans and protocols when pilot study operations require access to ARC work areas. Details will be discussed during the joint meeting between SPS and ARC.

SPS's SHSE Manual lists the H&S requirements and procedures including:

- Safety and health risk or Job Safety Analysis (JSA)
- Employee training requirements;
- Personal protective equipment (PPE);
- Regular safety meetings;
- Site control measures and
- Emergency response.

Job Safety Analysis (JSA) – A Job Safety Analysis (JSA) is a risk management tool that SPS uses to identify hazards and risks associated with a specific task. Risk control can be accomplished through the use of engineering or administrative controls and the use of PPE. JSA's will be prepared for major tasks associated with the pilot test and will be completed prior to beginning of the task. JSA's also include potential environmental risks. The JSA's will be developed jointly by the field staff and contractors performing the work. JSAs are maintained at SPS's office and will be reviewed by site workers prior to and throughout the pilot test.

Other training includes OSHA 40-hour HAZWOPER training and annual 8-hour Refresher as appropriate. Copies of OSHA and other training certificates will be maintained at the Site and in employee personnel records.

Personal Protective Equipment - Minimum PPE requirements required for the pilot test include the following:

- Hard hats;
- Safety glasses;
- Steel-toe boots;
- High-visibility, long sleeved shirts; and
- Leather work gloves.

Additional PPE may be required for specific work tasks and includes Tyvek coveralls, rubber boots, side shields on safety glasses and nitrile gloves when there is potential for contact with low pH solutions. Specific PPE requirements will be identified as part of the JSA discussed above.

Spill Prevention and Response – A new section has been included in Section 10 of the work plan to address a potential release of fluid during operation of the pilot test. This section includes the following discussion:

There are limited lengths of pressurized piping that are not located on top of existing containment (i.e., HDPE lined areas of the HLPs and perimeter ditches). New HDPE liner will be installed beneath any piping runs that are not located on top of existing liners. New liners will be designed to collect potential leaks and drain the fluids back to the existing FMS pond(s).

While the system is pressurized, there will be full time oversight that will immediately shut down the pump in event of a leak. As a further precaution, the pilot system will be pressure tested with clean water prior to the start of the pilot test.

In the event of an accidental release of FMS fluids outside of lined areas, SPS will take immediate action to first stop the release and contain any contain fluids that may have escaped. Once the leak has been stopped, cleanup of released fluids will be undertaken to the extent that fluids remain present on the surface. An estimate of the volume of fluid released will be made based on visual examination. SPS will notify NDEP and EPA within 24 hours of a release and provide documentation of the incident and cleanup actions taken within 30 days of the incident. The notification procedures described in SPS's HSSE plan will be followed.

SPS is not aware of a current Spill Prevention and Response Plan for operation of the FMS or of special containment for the existing pumping system. A detailed Spill Prevention and Response plan will be prepared if a full scale system is designed and operated.

11.0 Schedule

The schedule for the pilot test is shown in Figure 11-1. SPS will prepare and finalize the work plan in parallel with negotiating agreements with NDEP, EPA and ARC discussed in Section 5. SPS will begin procurement and construction after execution of the agreements.

Figure 11-1. Schedule for Pilot Test Implementation

Activity	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Draft Work Plan														
Agency Review														
Final Work Plan														
Agreements/Covenant not to sue														
Procurement														
Construction														
Startup														
Operations														
Draft Data Report														
Agency Review														
Final Report														

After the data report has been submitted to the Agencies and ARC, a decision will be made on whether to design and operate a full scale enhanced evaporation system. Details of the schedule for design, construction and startup of the full scale system will be included in the data report. To optimize success, a full scale system should be in place and operational for the 2017 evaporation season in May 2017.

12.0 References

Brown & Caldwell, 2010a, Arimetco Heap Leach Fluid Management System Operation and Maintenance Plan, Yerington Mine Site, Lyon County, Nevada. July 16, 2010

Brown & Caldwell, 2010b, Draft Electrical Hazards Removal Action Completion Report dated August 2010.

Brown & Caldwell, 2015, 2014 Annual Operations and Maintenance Report, Arimetco Heap Leach Fluid Management System, Yerington Mine Site, March 2015.

CH2M HILL, 2011a, Final Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Yerington Copper Mine, September 2011.

CH2M HILL, 2011b, Supplemental Remedial Investigation Report, Arimetco Facilities Operable Unit 8, Anaconda Yerington Copper Mine, Yerington, Nevada, October 2011.

CH2M HILL, 2012, Draft Final Feasibility Study for Arimetco Facilities Operable Unit 8 Heap Leach Pads and Drain-down Fluids Anaconda-Yerington Copper Mine, Yerington, Nevada, May 2012.

SRK, 2013, Yerington Mine – Fluid Management System Study, April 2103

USEPA, 2007, Administrative Order for Remedial Investigation and Feasibility Study (RI/FS) for the Yerington Mine Site, issued to Atlantic Richfield Company, January 12, 2007.

USEPA, 2009, Administrative Order on Consent and Scope of Work, issued to Atlantic Richfield Company, April 21, 2009.

Figures

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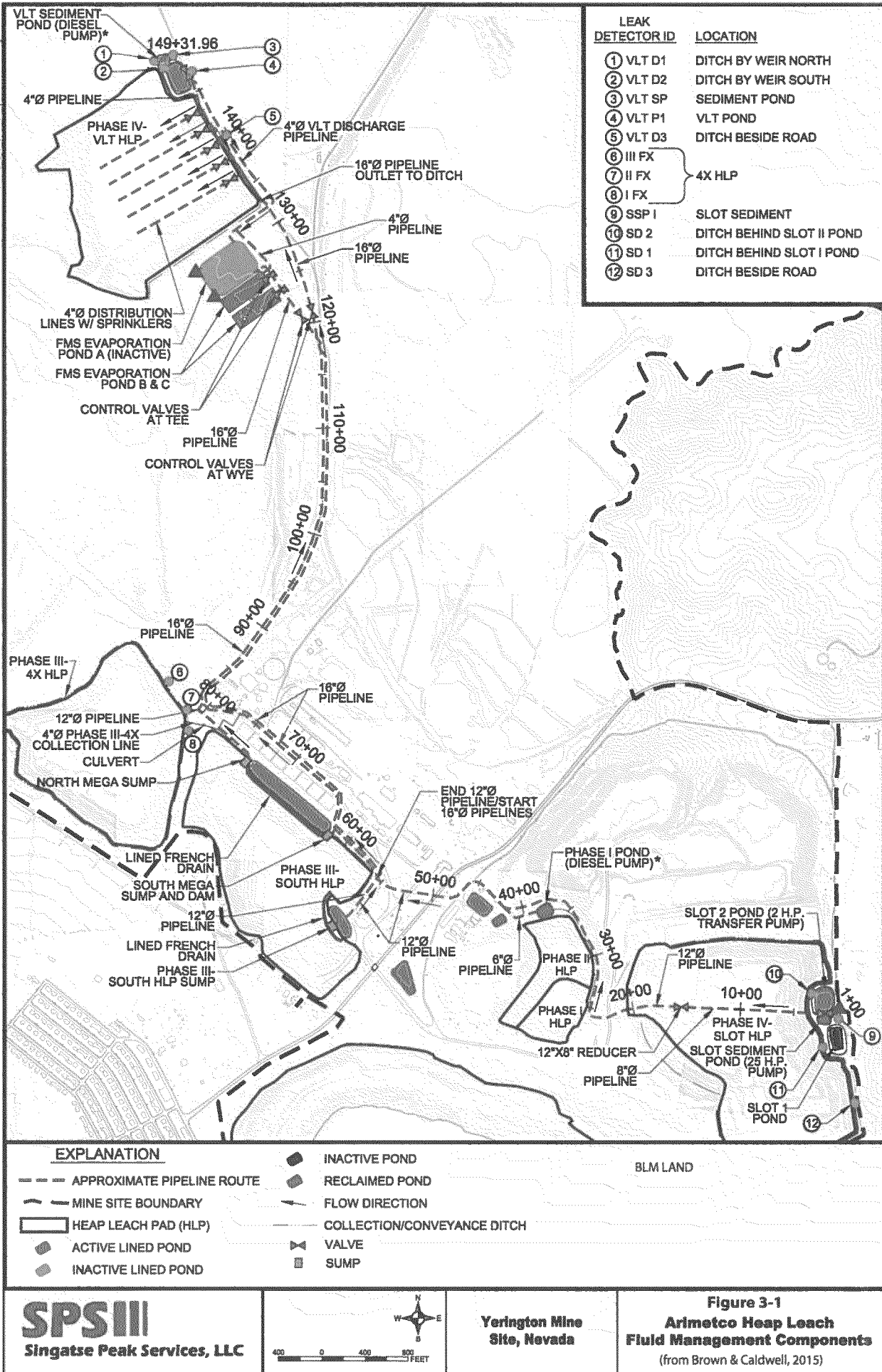


Figure 7-1. Sprinkler Irrigation Pilot Test Location
VLT Heap Leach Pad
 (all operations are on SPS private land)

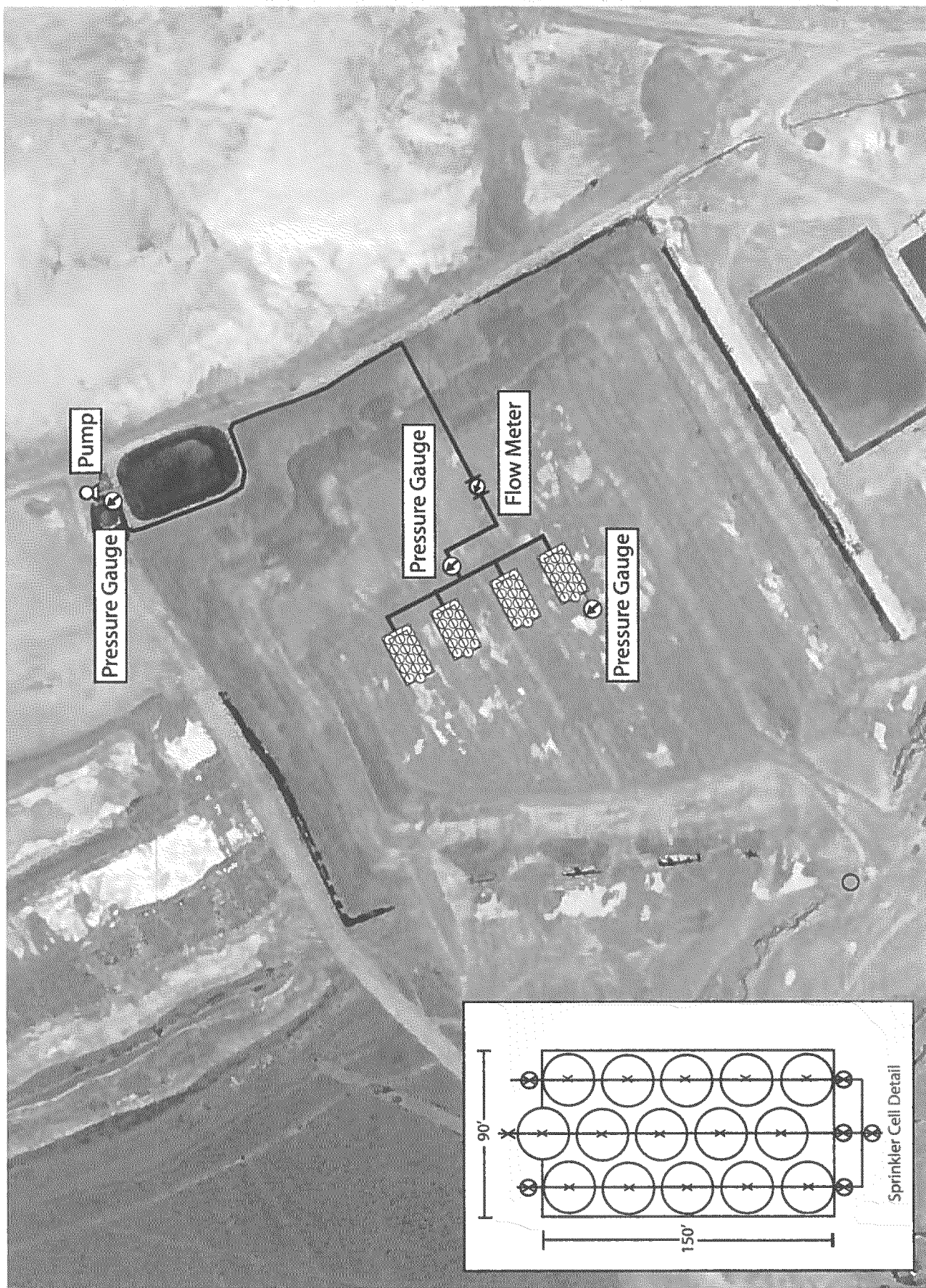
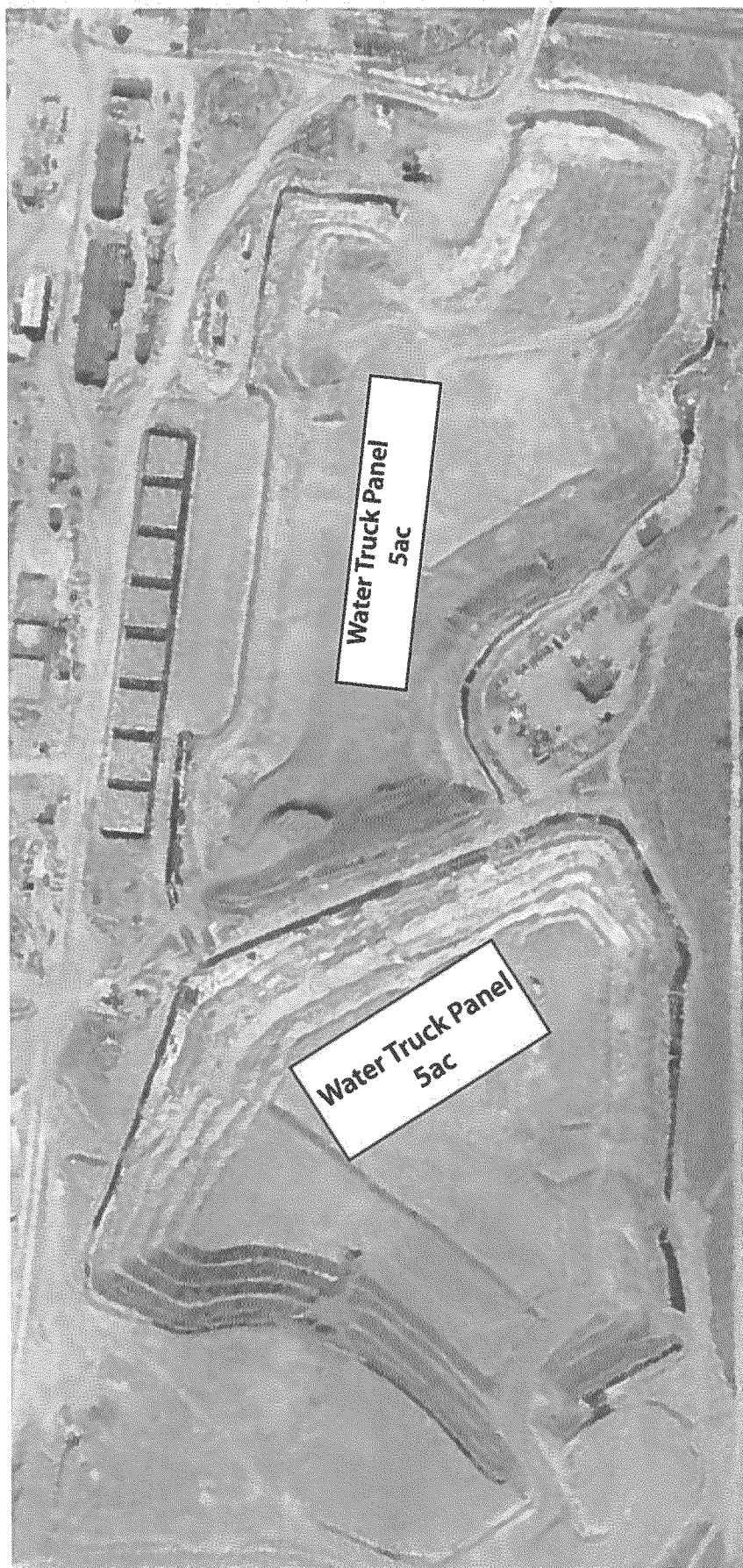


Figure 7-2. Water Truck Pilot Test Location - Phase III-4X, Phase III-South Heap Leach Pads

(all operations are on SPS private land)



*Panel locations are conceptual and will be finalized based on field conditions.

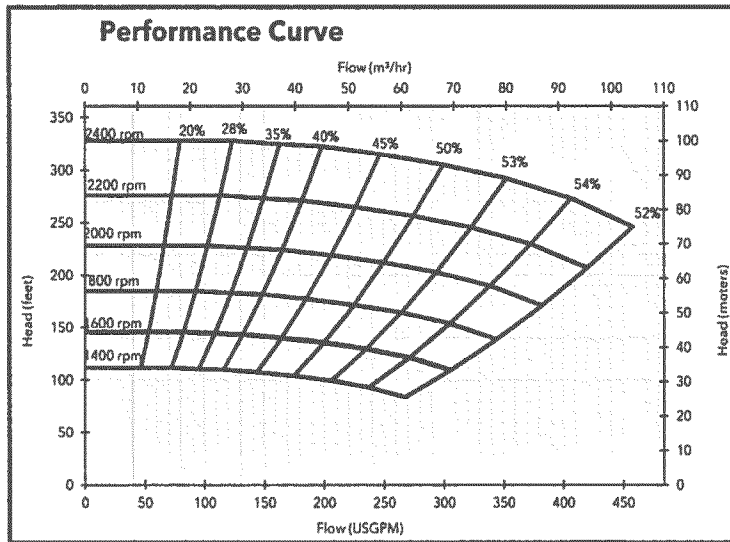
Appendices

Appendix A	Pump Curves
Appendix B.1	Senninger Irrigation Specifications
Appendix B.2	Nelson Irrigation Specifications
Appendix C	Specmeter Soil Moisture Specifications
Appendix D	FMS Pond Elevation vs. Capacity Curves

Appendix A Pump Curves

Arimetco Fluid Management System Pump Configuration			
Location	Pump Manufacturer	Model	Pump Size (horse power)
Slot Sediment Pond (SSP)	Durco	MK3 STD. 3" x 2"	25
VLT Sediment Pond Backup Pump	Durco	MK3 STD. 3" x 2"	15
VLT Storage Pond Diesel Pump	Godwin	HL 80	40
Spare Pumps (Curve No. CN0497R01)	Goulds	8SHK6 2" x 2-1/2"-8	20

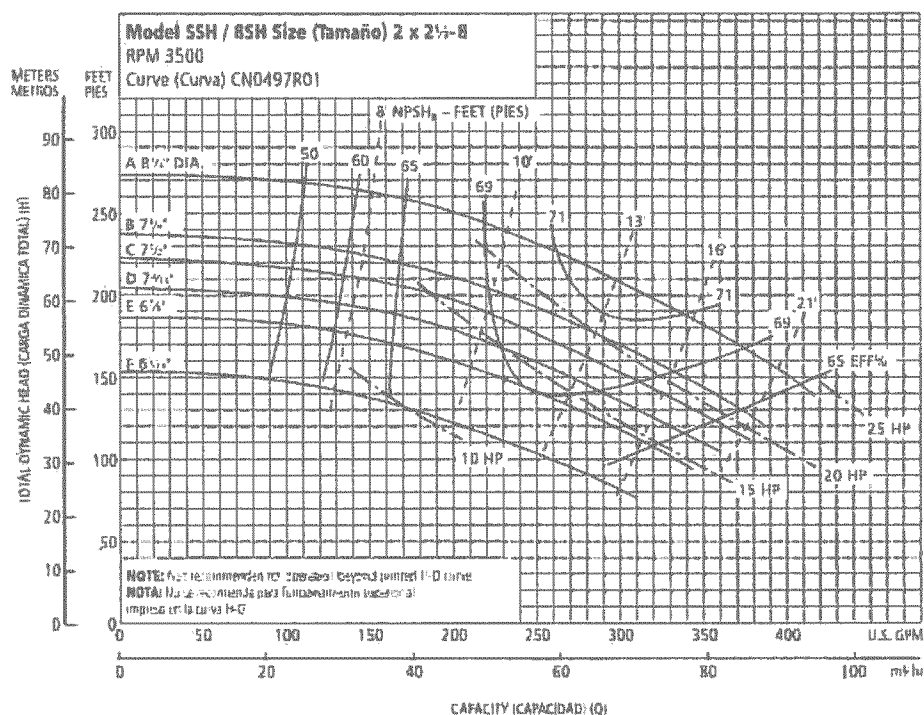
VLT Storage Pond Diesel Pump – Godwin HL 80



Q (gpm)	Performance Curve					
	Head (Feet)					
	1400 RPM	1600 RPM	1800 RPM	2000 RPM	2200 RPM	2400 RPM
0	110	145	185	230	275	330
50	109	144	184	229	274	329
100	108	143	183	228	273	328
150	107	142	182	227	272	327
200	100	135	175	222	267	322
250	89	124	166	213	259	315
300		110	153	200	250	305
350			135	182	237	293
400				160	217	275
450					190	250

Goulds 8SHK6 2 x 2-1/2 (20 HP) – 8 Curve No. CN0497R01 – Spare Pump

Performance Curves – 60 Hz, 3500 RPM Curvas de Funcionamiento – 60 Hz, 3500 RPM



Optional Impeller, Impulsor Opcional		
Impeller Code, Código del Impulsor	Dia., Estándar	HP Rating, Estándar HP Potencia
A	8 1/4"	25
B	7 7/8"	20
C	7 1/2"	20
D	7 1/4"	15
E	6 3/4"	15
F	6 1/2"	10

NOTE: Pump will pass a sphere
to 7/8" diameter

NOTA: La bomba pasará una
esfera a 7/8" diámetro.

Q (gpm)	Head (ft)
0	240
50	236
100	231
150	224
200	210
250	192
300	170
350	143
400	110

Durco Model MK3 STD. 3" x 2" – 15 HP located on VLT Sediment Pond

Durco Pump (Curve No. MIII834V)

Q (gpm)	Head (ft)
0	200
40	198
80	197
100	196
140	191
180	181
200	175
240	160
280	145
300	135
340	108
380	82

Durco Model MK3 STD. 3" x 2" – 25 HP located on Slot Sediment Pond – Pump Curve developed by testing

Flow	Head (psi)	Head (feet)
0	101	233
180	100	231
330	94	217
360	92	213
410	88	203
460	84	194
500	80	185